PATENT SPECIFICATION

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Complete Specification Accepted: March 30, 1938.

COMPLETE SPECIFICATION

Improvements in Centrifugal Fans

I, HAROLD FREDERICK HAGEN, a Citizen of the United States of America, of Dedham, County of Norfolk, State of Massachusetts, United States of America, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention relates to fans or blowers and relates more particularly to an efficient fan adapted for high speed operation.

The fan or blower of the present invention, represents an improvement over the known art in that it may be operated at higher speeds for the same head. For a given head, electric motors for driving a fan or blower are cheaper when designed for high speed operation. Furthermore, steam turbines which are often used for driving fans or blowers, as on ships, are more efficient at high speeds of rotation.

The fan of this invention differs from the known art in that the radial depth of the working portion of each fan blade decreases, along its delivery portion, towards the back plate of the wheel. The delivery edge of each blade lies along a curve of decreasing radius towards the back plate, the radius at any point on the curve being determined from the formula:

$$\text{Head (constant)} = \frac{w W_n r}{g}$$

where w = angular velocity.
W_n = rotative velocity component imparted.
r = radius at any given point.
g = acceleration due to gravity.

Every element of each blade lies on a curved surface which is a conoid. A conoid is a warped surface as distinguished from a surface of revolution and is formed by a straight line generatrix constantly touching two line directrices, one of which is straight and the other curved, and moving parallel to a given plane. In the present case, the generatrix preferably touches a base line which coincides with the axis of the fan wheel, and a curve which is so chosen that the blade is formed as a helix with increasing pitch towards the back plate.

Each blade is provided with a curved inlet portion with substantially a constant radial depth, which serves to pick up the air entering the fan and to deliver it equally upon all portions of the delivery portion of the blade. The delivery portion of each blade is given however, a decreasing radial depth so that the blade works the same amount on each particle of air going through the fan. Thus, a particle of air leaving the delivery edge of the blade at the back plate, is worked upon by the blade the same amount as a particle of air leaving the blade at the opposite extremity of the delivery edge.

The invention will now be described with reference to the drawings of which:

Fig. 1 is a section along a vertical plane through a fan or blower according to this invention, in the form of a roof ventilator.

Fig. 2 is a sectional view along the line 2—2 of Fig. 1;

Fig. 3 is an exterior view in profile, of the complete roof ventilator;

Fig. 4 is an enlarged profile view of the fan wheel;

Fig. 5 is a sectional view along the lines 5—5 of Fig. 4;

Fig. 6 is a sectional view along the lines 6—6 of Fig. 4, and

Fig. 7 is a geometrical projection illustrating the development of the blades of Fig. 4 as conoidal surfaces.

Figs. 1, 2 and 3 illustrate the general assembly of a fan or blower utilizing the improved fan wheel of this invention. The wheel illustrated generally by 10 has the four curved blades 11. The wheel 10 is mounted on the shaft 12 of the motor 13.

The roof ventilator illustrated is designed for mounting upon the roof of a building and receives air from the interior of the building through the opening 14 in the roof 15 thereof. The casing 16 serves as the fan inlet, and the inlet portions of the blades 11 extend into

[*Price* 1/-]

the casing 16. The casing 16 has a square base and a cylindrical upper portion. The parabolic curves of Figs. 1 and 3 are the lines of transformation. Above the upper edge 17 of the casing 16 and between it and the back plate 18 of the fan wheel, the delivery edges of the blades extend. The back plate 18 turns the air and delivers it as shown by the arrows indicating air flow, of Fig. 1; through an opening 19 in the housing to be deflected by the annular member 20, from the ventilator. The shield 21 serves to protect the motor 13 from the elements.

In the embodiment of the fan wheel illustrated, the hub 22 and blades 11 are cast as an integral unit. The hub 22 tapers from the back plate 18 to its extreme inner portion 23, as illustrated more clearly by Fig. 4. The hub 22 increases rapidly in diameter as it closely approaches the back plate 18 and its curved outer surface at 25 cooperates in turning the air from the wheel in quiet, efficient flow.

Fig. 7 illustrates the development of one of the blades upon the cylindrical surface of a quadrant of a cylinder. The line AB is the line, along which the lower end of the generatrix lines moves while the upper end moves along the curve CD. The successive positions of the generatrix are shown at BC, EF, GH, IJ, KL and MN. The curve followed by the generatrix is so chosen that the generatrix forms the blade as a helix with increasing pitch towards the back plate.

The line CD of Fig. 7 since lying on the surface of a cylinder, is spaced the same distance from the line AB, at all points. The outer curve of the inlet portion of the blade coincides with the curve along the line CH, but departs from it to follow the line HO along the delivery edge, so as to provide a delivery portion having decreasing depth towards the back plate as determined by the formula.

The lower or base portion of the blade is sloped to fit along the hub 22 of the wheel.

The shaded portion of Fig. 7 illustrates the surface of the blade after it has been shaped to provide a delivery portion having decreasing depth towards the back plate, and to fit along the hub of the wheel. Other characteristics of the blade are: It has a constant radial depth in the entry portions CH; it lies along a surface of a helix having increasing pitch towards the back plate; its delivery edge terminates in a plane transverse to the fan wheel; its inlet edge PC (Figs. 2, 4 and 7) lies along a line passing through the axis of the fan wheel, and its delivery edge (Fig. 2) at the back plate terminates in a plane in which the axis of the wheel lies.

Characteristics of the embodiment of the fan wheel illustrated. The entering edges of opposite blades lie substantially in a plane transverse to the axis of the wheel (Fig. 2). The entering edge of each blade lies in a plane in which the delivery edge of the adjacent blade terminates.

Since all elements of each blade extend in lines radiating from the center line of the shaft, centrifugal forces are a minimum and the fan may be rotated at very high speeds without fear of mechanical failure. The fan is not only very quiet and efficient in operation, but may be easily and economically manufactured.

While one embodiment of the invention has been described for the purpose of illustration, it should be understood that the invention is not to be limited to the exact arrangement described, as many departures may be made by those skilled in the art, after having had access to this disclosure.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is:—

1. A blade for a centrifugal fan having a back plate to which the delivery portion of the blade is attached, characterized by the fact that the inlet portion of the blade has a substantially constant depth throughout while the delivery portion of the blade has a gradually decreasing depth.

2. A blade in accordance with claim 1, characterized by the fact that the blade is curved throughout.

3. A blade in accordance with claim 2, characterized by the fact that all elements of the blade extend in radial lines.

4. A blade in accordance with claim 2, characterized by the fact that the blade is formed as a helix.

5. A blade in accordance with claim 3, characterized by the fact that the blade is formed as a helix.

6. A blade in accordance with claim 4, characterized by the fact that the helix is of increasing pitch towards the back plate.

7. A blade in accordance with claim 5, characterized by the fact that the helix is of increasing pitch towards the back plate.

8. A blade in accordance with claim 1, characterized by the fact that the blade has the surface of a conoid.

9. A blade in accordance with claim 8, characterized by the fact that the blade has the form of a helix.

10. A blade in accordance with claim 9, characterized by the fact that the helix has increasing pitch towards the back plate.

Dated this 11th day of May, 1937.

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Fig. 1.

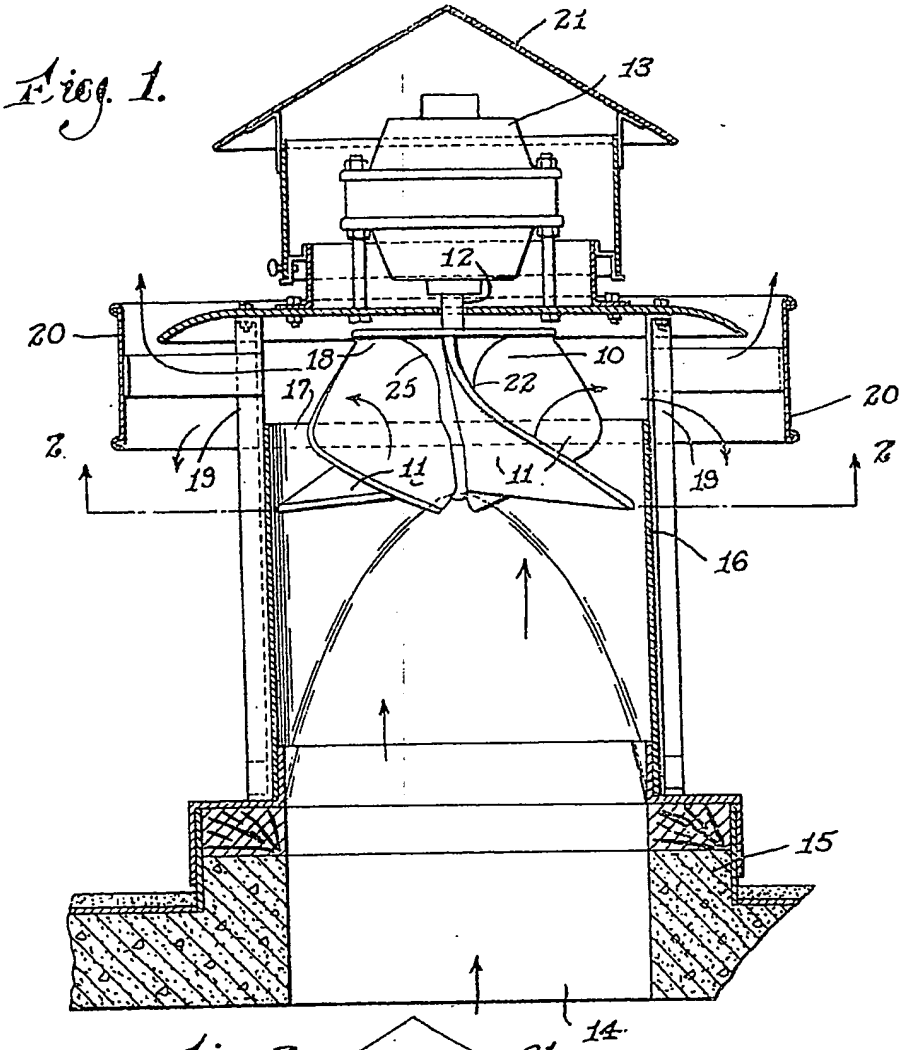

Fig. 3

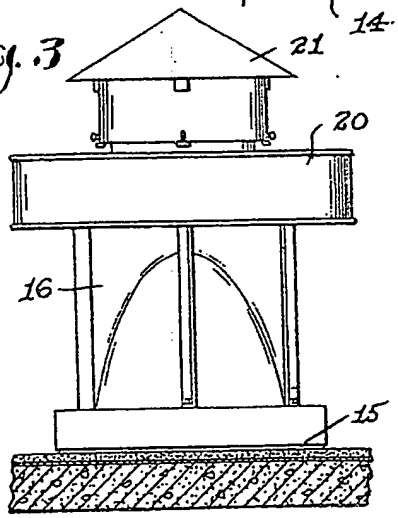

Fig. 2.

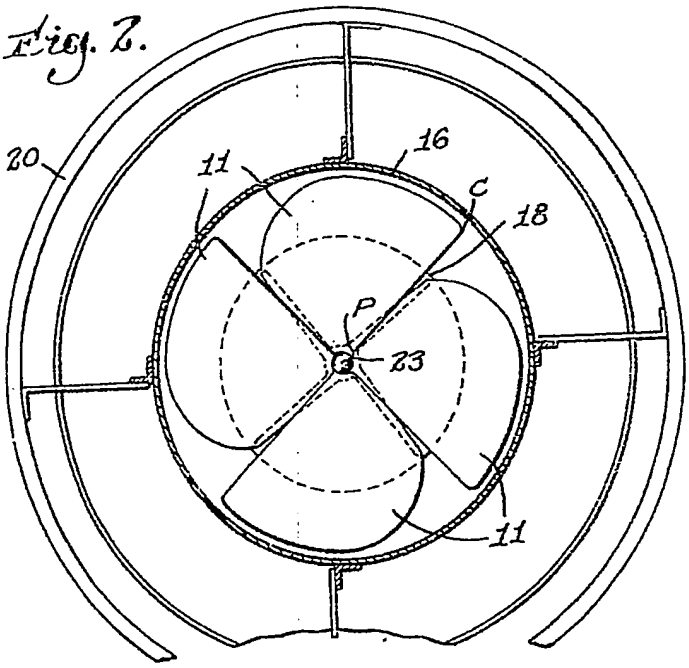

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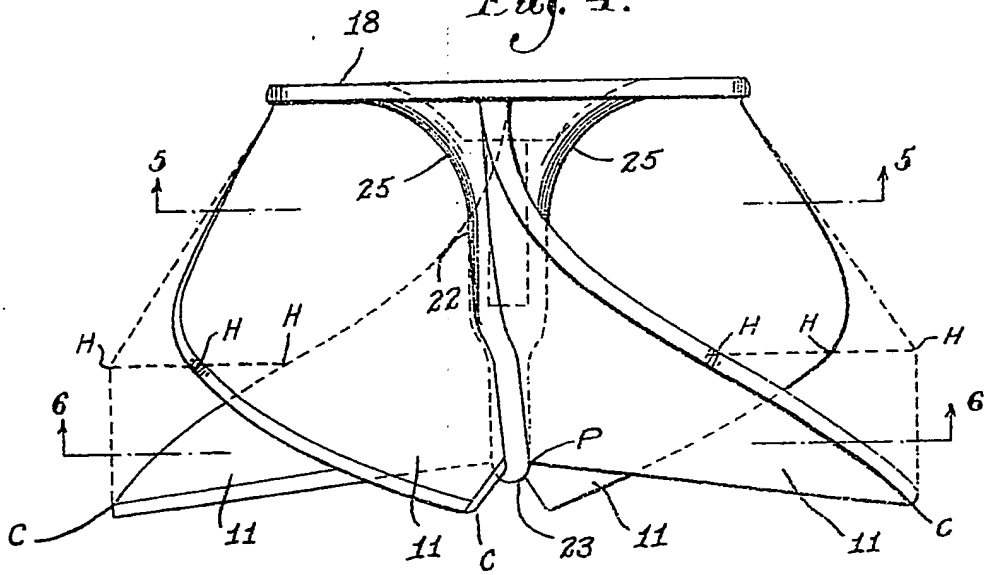
Fig. 4.



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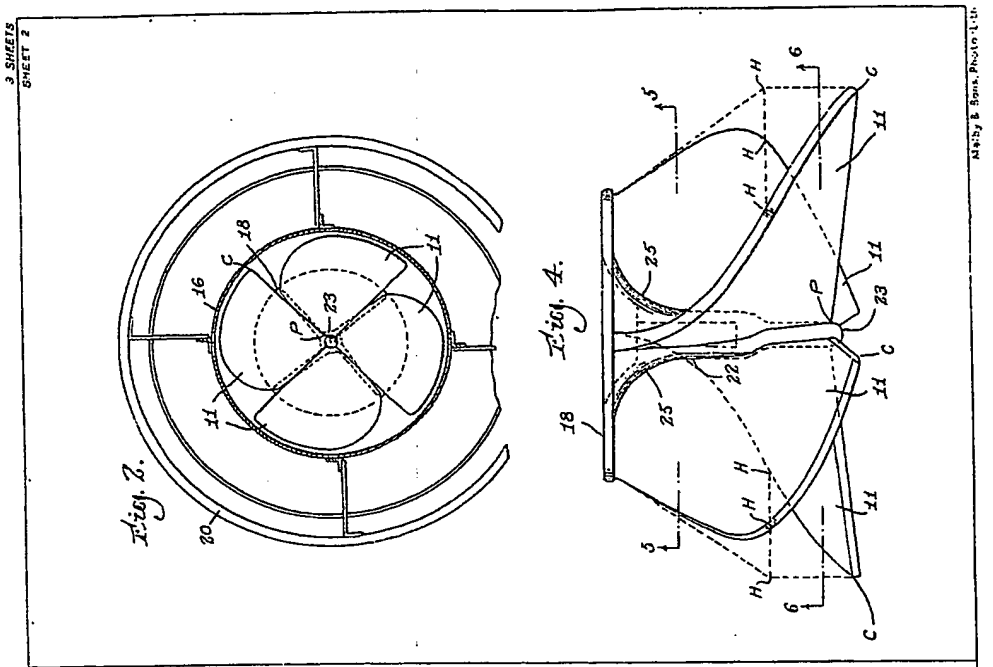
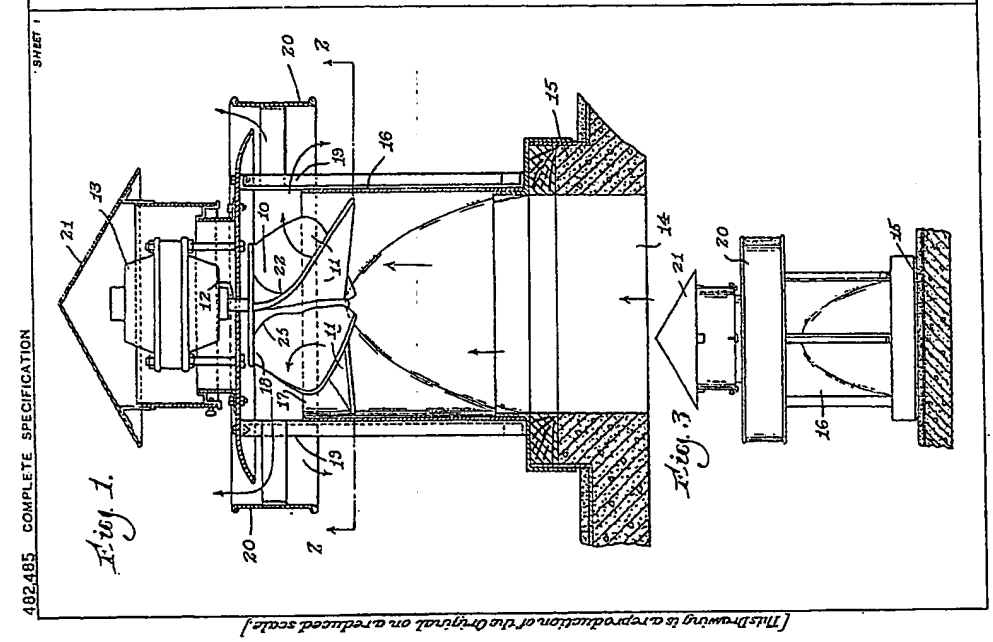




[This Drawing is a reproduction of the Original, on a reduced scale.]

Fig. 7

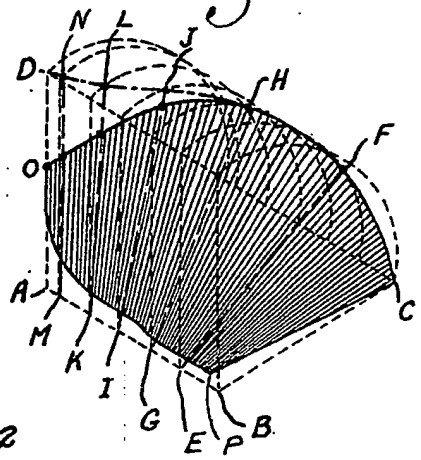


Fig. 5.

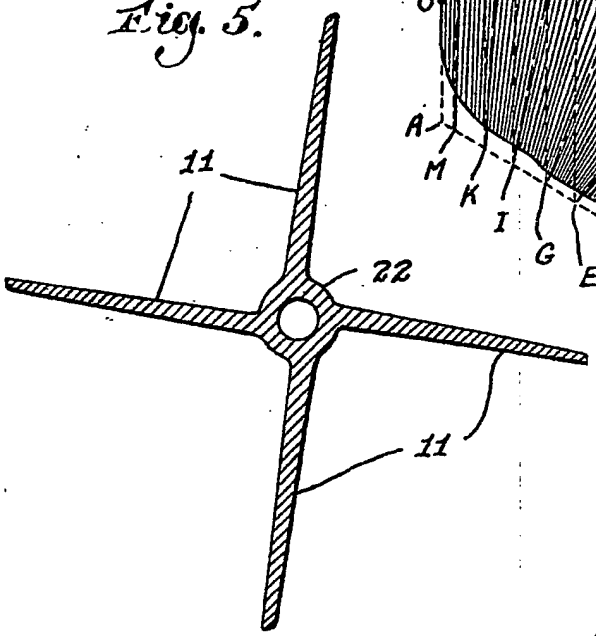
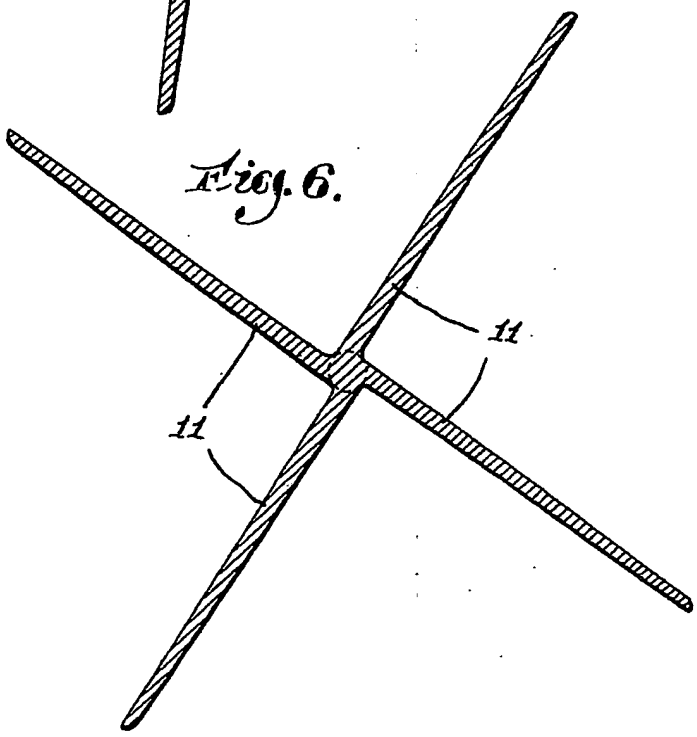


Fig. 6.



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